GTE-ERS
TECHNICAL LIBRARY
02084

ESC-0254-92-01

B&K 280

SERVICE MANUAL

B&K PRECISION Model 280

DIGITAL MULTIMETER

B&K PRECISION

Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

DESCRIPTION

The Model 280 Digital Multimeter has been designed to accurately measure DC and AC volts, DC and AC current, and Ohms. The operation of the Function switch selects the type of measurement to be performed.

A HI-LO Ohms feature permits making in-circuit resistance measurements at voltage levels below the threshold conduction of semiconductors. The indicator shows H or L, depending on the range selected.

The Model 280 is battery operated using four "C" size batteries, Ni-Cad, alkaline or carbon zinc. Provision is also made for a charger/converter unit (B & K Model BC-28) which is plugged into a jack located on top of the unit.

An overload protection system provides maximum protection of the instrument in the event of extreme overload accidents.

Two test leads, red and black, are provided.

SPECIFICATIONS

DC Voltage

Ranges:	±0-1000mV, 10V, 100V, 1000V.
Accuracy +25°C ±1°C:	±0.5% of reading, ±0.5% full range, ±1 LSD, 1000mV, 10V, 100V ranges. ±1.0% of reading, ±0.5% of full range, ±1 LSD, 1000V range.
Temperature Coefficient, +15°C to +35°C:	±0.025%/°C.
Input Impedance:	10 meg ohms.
Polarity Indications:	Automatic; minus sign shown, plus sign implied.
Circuit Protection, All Voltage Ranges:	±1000VDC or AC RMS.

AC Voltage

(Average reading circuitry calibrated to read RMS value of pure sign wave.)

Ranges:	0-1000mV, 10V, 100V, 1000V
Accuracy +25°C ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000mV, 10V, 100V ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000V range.
Temperature Coefficient, +15°C to 35°C:	±0.025%/°C.
Frequency Response:	50-200 Hz.
Input Impedance:	10 meg ohms.
Circuit Protection, All Voltage Ranges:	±1000VDC or AC RMS.

DC Current

Ranges:	0-1000μA, 10mA, 100mA, 1000mA.
Voltage Drop (Measured at Instrument Terminals):	Nominal 100mV full range, 1000μA, 10μA, 100μA ranges. Nominal 300mV full range, 1000mA range.
Accuracy, +25°C, ±1°C.	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000μA, 10mA, 100mA ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000mA range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Polarity Indication:	Automatic; minus sign shown, plus sign implied.
Circuit Protection, All Ranges:	Fuse and Diode. Fuse (7AG-1A) externally accessible.

AC Current

Ranges:	0-1000μA, 10mA, 100mA, 1000mA.
Voltage Drop (Measured at Instrument Terminals):	Nominal 100mV RMS full range, 1000μA, 10mA, 100mA ranges. Nominal 300mV RMS full range, 1000mA range.
Accuracy, +25°C, ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000μA, 10mA, 100mA ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000mA range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Frequency Response:	50-200 Hz.
Circuit Protection, All Ranges:	Fuse and diodes. Fuse externally accessible.

Resistance

Ranges:	0-100Ω, 1000Ω, 10KΩ, 100KΩ, 1000KΩ, 10MΩ.
Polarity	Plus (+) jack is positive for all ranges.
Accuracy, 25°C ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 100Ω, 100Ω, 1000Ω, 10KΩ, 100KΩ, 1000KΩ ranges. ±1.5% of reading, ±1.0% of full range, ±1 LSD, 10MΩ range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Test Currents:	100Ω - 1mA Lo (100mV, full range) 1000Ω - 1mA Hi (1V, full range) 10KΩ - 10μA Lo (100mV, full range) 100KΩ - 10μA Hi (1V, full range) 1000KΩ - 100nA Lo (100mV, full range) 10MΩ - 100nA Hi (1V, full range)
Circuit Protection:	1000KΩ and 10MΩ: Continuous ±1000VDC or AC. 10KΩ and 100KΩ: Continuous ±400VDC or AC. Will withstand momentary overloads to ±1000 VDC or AC. 100Ω and 1000Ω: Continuous ±125VDC or AC. Will withstand momentary overloads to ±1000VDC or AC.

General

Operating Temperature:	0°C to +50°C.
Overrange Indication, All Ranges and Functions	The display will flash when the input exceeds the value of the range selected.

Settling Time, All Ranges and Functions	Less than one second, typically 0.5 second.
Power Requirements:	4 "C" size batteries, Ni-Cad, Alkaline or Carbon Zinc, with provision for charger/converter. NOTE: Batteries or charger/converter are not supplied.
Battery Life:	Better than 50 hours (with Alka batteries, continuous use).
Accessories (Included):	2 Test Leads.
Size:	4 3/8" W x 6 3/8" H x 2" D.
Weight:	2 lbs.

DISASSEMBLY INSTRUCTIONS

1. Loosen captive screw on bottom cover and remove bottom cover.
2. Remove batteries.
3. Remove four screws from bottom of main case.
4. Unsolder the plus (+) test lead connection from printed circuit board and remove top cover.
5. Remove black felt switch cover, when used, and the Range and Function switch knobs.
6. Lift the top of the metal/paper shield and remove red plastic display cover.
7. Remove two screws from top of printed c boards and remove boards from case.

   NOTE: Care should be taken when rer printed circuit boards from ca may be necessary to squeeze the b clips in order to remove printed c boards from the case.
8. Unsolder the clip attached to shield fro switch frame and remove shield and ins from printed circuit boards.

REASSEMBLY

1. Replace insulator and shield around bottom portion of the printed circuit board.
2. Insert printed circuit boards into case and replace two mounting screws (one in each board) and tighten screws.
3. Solder clip attached to shield to the Function switch frame.
4. Place red plastic display cover into proper position.
5. Replace the Range and Function switch knobs, and black felt switch cover, if used.
6. Place top cover into position. Properly po the plus (+) test lead terminal onto printe cuit board.
7. Replace four screws holding top cover to and tighten.
8. Solder plus (+) lead to printed circuit board
9. Replace the four "C" batteries into case serving proper polarity.
10. Place bottom cover into position and ti captive screw.

CALIBRATION PROCEDURES

The instrument should not require calibration unless repairs have been made that change the factory calibration. Check for proper operation of all functions before attempting to calibrate the instrument.

The following procedure requires a low-impedance, constant voltage source of 0.1% accuracy or better. Use of sources less accurate will reduce the accuracy of the instrument.

Preliminary Instructions

Models Below Serial No. 39-03500 (Refer to Fig. 1 for Location of Adjustments.

1. Loosen captive screw on bottom cover and remove cover and batteries.
2. Remove the four screws holding top cover.
3. Unsolder the plus (+) jack from edge of printed circuit board and solder a short wire to this point to serve as a temporary (+) input terminal.
4. Remove the top cover, exposing the printe cuit boards.
5. Replace batteries and back cover and pr with Step 1 under "Procedure."

Models Above Serial No. 39-03500 (Refer to for Location of Adjustments.

1. Loosen captive screw on bottom cover ar move cover. It may be necessary to p piece of tape over batteries to hold them in
2. Proceed with Step 1 under "Procedure."

Procedure

NOTE: It is important that this procedu followed in the order given below.

1. Set Function switch to DCV, and Range swi 1000mV scale.

2. Short input terminals together.

3. Turn R25, Zero Adjust control, so that minus (-) sign is just flickering. Then turn until the minus sign is off.

   NOTE: If zero is not obtained within the adjustment range of R25, the unit is defective and cannot be calibrated.

4. Apply +2mVDC to the input terminals and adjust R22, A/D Zero, for a zero reading.

5. Apply +10mVDC and -10mVDC to the input terminals and check reading for symmetry. If readings are not symmetrical, adjust R25, Zero Adjust control, until symmetry is obtained.

6. Apply +1 volt DC and -1 volt DC to input terminals and adjust R23, Range Adjust, so that the range error is split between polarities.

7. Set Function switch to OHMS, and Range switch to 100Ω scale.

8. Connect a 90-ohm, ±0.1%, resistor across the input terminals.

9. Adjust R24, Lo Ohms Cal., for a 90.0 reading.

10. Set Range switch to 1KΩ scale.

11. Connect a 900-ohm, ±0.1% resistor across input terminals.

12. Adjust R21, Hi Ohms Cal., for a 900 reading.

13. Check all DCV, ACV, DCA, ACA, and OHMS scales for correct readings.

14. Reassemble unit.

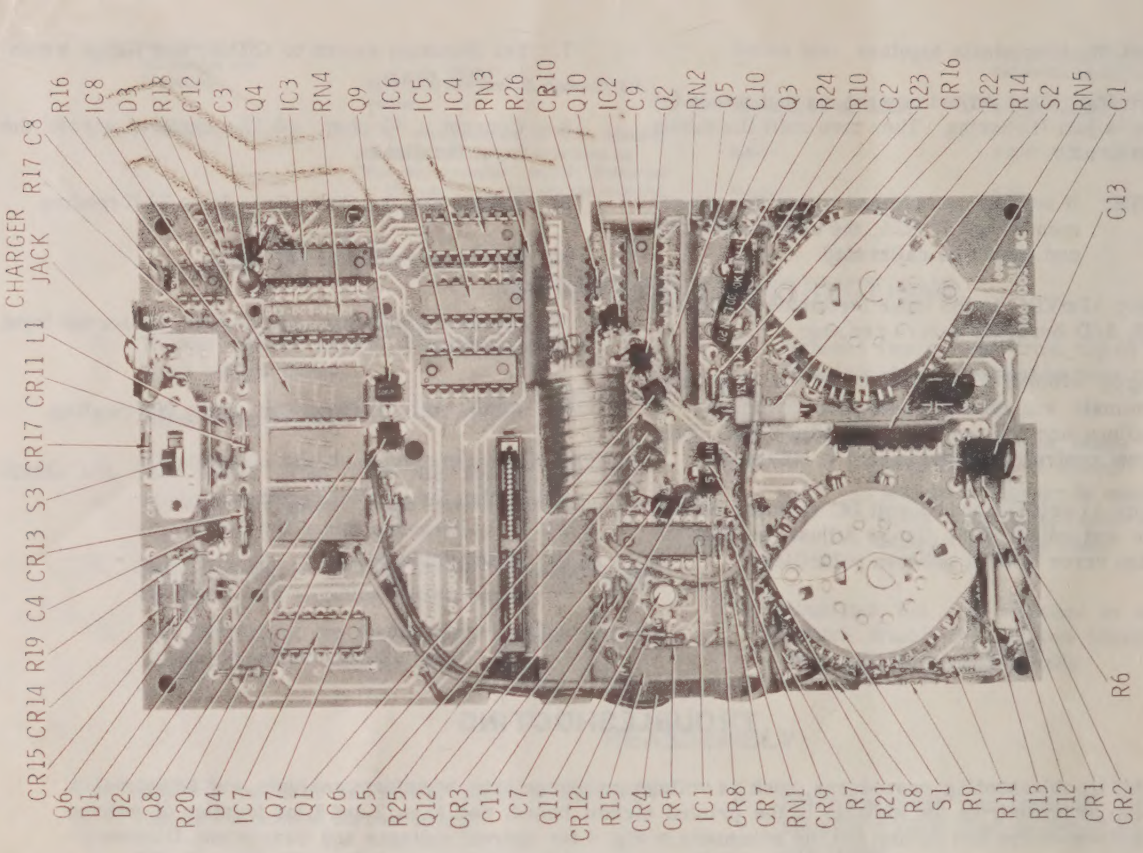
TROUBLESHOOTING

All troubleshooting procedures, such as voltage measurements, waveform analysis, and adjustments, can be made from the top side of the printed circuit board. See Figs. 2 and 3 for location of voltage and waveform test points, and the schematic in Fig. 4 for correct voltages and waveforms. Disassembly of the printed circuit board will only be necessary if a component needs replacing.

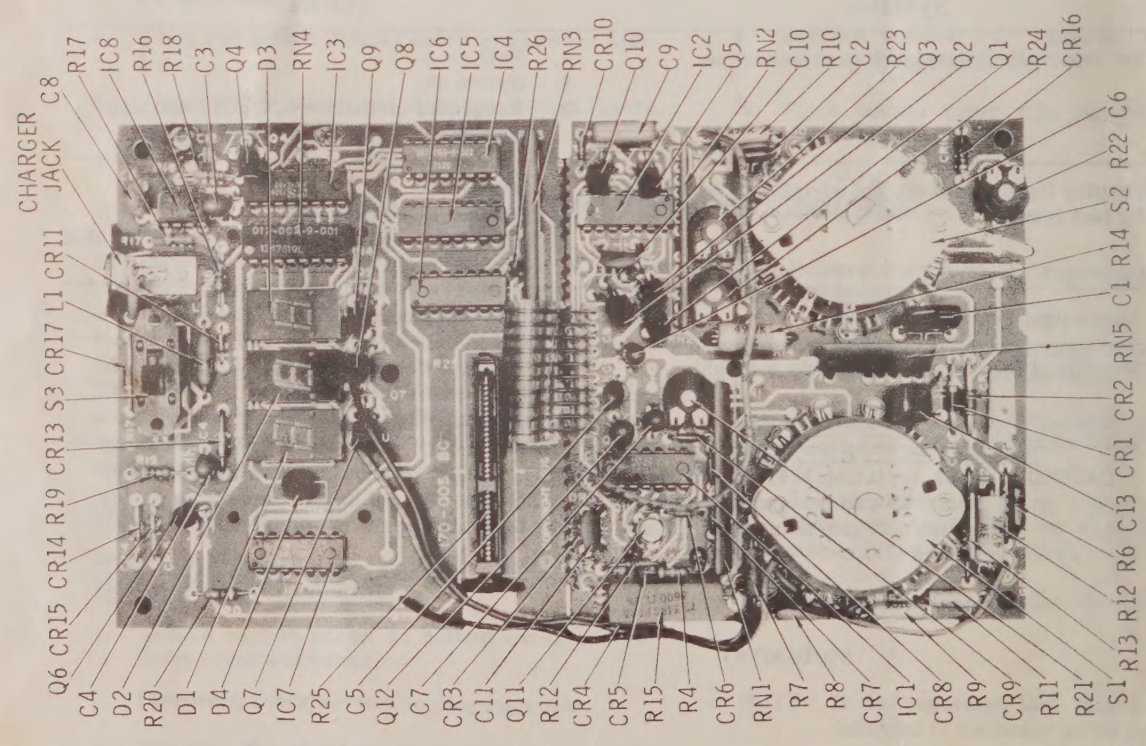
TROUBLESHOOTING CHART

Symptom	Check
Set inoperative; display does not come on.	1. Batteries. 2. Switch S3. 3. Integrated circuits - IC4, IC8, IC3 (See CAUTION Note).
Display light comes on, but no value is indicated by test leads.	1. Fuse F1. 2. Broken test lead wire. 3. Test lead connection not soldered to printed board.
Minus light remains flashing.	1. Bad Zero control R25.
Any one of display elements does not light.	1. Replace display element D1, D2, or D3. 2. Transistor Q7, Q8, Q9. 3. Range Switch S1 (Decimal Points).

CAUTION: When replacing IC4, IC3, IC5, IC6, or IC7, a static charge from personnel and/or materials can permanently damage these devices. Do not handle pins of the device except with ground straps. Do not replace these devices with voltage applied to the circuit.


CHARGER JACK
R17 C8
R16 IC8 D3 R18 C12 C3 Q4 IC3 RN4 Q9 IC6 IC5 IC4 RN3 R26 CR10 Q10 IC2 C9 Q2 RN2 Q5 C10 Q3 R24 R10 C2 R23 CR16 R22 R14 S2 RN5 C1 C13
CR15 CR14 R19 C4 CR13 S3 CR17 CR11 L1
Q6 D1 D2 Q8 R20 D4 IC7 Q7 Q1 C6 C5 R25 Q12 CR3 C11 C7 Q11 CR12 R15 CR4 CR5 IC1 CR8 CR7 RN1 CR9 R7 R21 R8 S1 R9 R11 R13 R12 CR1 CR2 R6

Models Below Serial No. 39-03500


CHARGER JACK
C8 R17 IC8 R16 R18 C3 Q4 D3 RN4 IC3 Q9 Q8 IC6 IC5 IC4 R26 RN3 CR10 Q10 C9 IC2 Q5 RN2 C10 R10 C2 R23 Q3 Q2 Q1 R24 CR16
Q6 CR15 CR14 R19 CR13 S3 CR17 L1 CR11
C4 D2 R20 D1 D4 Q7 IC7 R25 C5 Q12 C7 CR3 C11 Q11 R12 CR4 CR5 R15 R4 CR6 RN1 R7 R8 CR7 IC1 CR8 R9 CR9 R11 R21 S1
R13 R12 R6 C13 CR1 CR2 RN5 C1 R14 S2 R22 C6

Models Above Serial No. 39-03500

Fig. 1. Top View of Printed Circuit Board — Parts Identification.

PARTS LIST

TE:

ndard value resistors and capacitors are not listed. Minimum rge $5.00 per invoice. Orders will be shipped C.O.D. unless vious open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

Ref. No	Part No.	Description
		TRANSISTORS
thru Q3,	176-050-9-001	MPS-6515 Silicon Transistor
Q7 thru Q9	176-051-9-001	2N5818 PNP Silicon Transistor
Q6, Q10	177-015-9-001	MPS-6519 NPN Silicon Transistor
	182-033-9-001	FET, Dual "N" Channel J-FET
	182-036-9-001	FET (Input Clamp Diode)
		INTEGRATED CIRCUITS
, IC2	307-060-9-001	324 Quad Op-Amp
	307-001-9-001	9511 | Note Location of
	307-068-9-001	74C48 ∫ Jumper, Pin 5.
	307-066-9-001	C-MOS, LSI Counter Latch
	307-064-9-001	4040
	307-062-9-001	4013
	307-063-9-001	4011
	307-065-9-001	NE555V
		DIODES AND RECTIFIERS
1, CR2, 17	151-018-9-001	Rectifier, 600V, P1V, 1 Amp Silicon
3 thru 11	151-038-9-001	1N4148 Silicon Diode
12	152-061-9-001	Zener, 6.8V, 10%, 1 Watt 1N4763
13	152-039-9-001	Zener, 12V, 5%, 1 Watt 1N4742A
14	152-068-9-001	Zener, 7.5V, -3%+10%, 500m Watt
15	152-062-9-001	Zener, 4.3V, 5%, 500m Watt 1N749A
16	152-066-9-001	Zener, 6.4V, Reference Diode 1N4565
		CAPACITORS
	025-066-9-001	.01 mfd, 600V, 20% Polyester
, C13	025-096-9-001	.047 mfd, 100V, 10% Polyester
thru C6	027-010-9-001	10 mfd, 16V, 20% Tantalum
	027-009-9-001	15 mfd, 10V, 20% Tantalum
	020-137-9-001	270 pf, 500V, 10%, Ceramic Disc
	025-095-9-001	.033 mfd, 100V, 10% Polyester
2 ‡	020-139-9-001	.01 mfd, 25V, -20 +80 Ceramic Disc
		CONTROLS AND RESISTORS
	004-125-9-001	0.098Ω, 1/2 Watt, Wirewound
	004-147-9-001	0.9Ω, 1%, 1/2 Watt, Wirewound
	011-072-9-001	9Ω, 1%, 1/2 Watt, Metal Film
	011-073-9-001	90Ω, 1%, 1/2 Watt, Metal Film
0	011-102-8-474	470K, 5%, 1/2 Watt, Metal Film
1	011-079-9-001	4.99 meg, 1%, 1/4 Watt, Metal Film
2, R14	011-085-9-001	49.9K, 1%, 3 Watt, Metal Film
3	004-149-9-001	449Ω, 1%, Metal Film Special Plate
5	004-151-9-001†	3.6K, 5%, 3 Watt, Special Metal Glaze
1	008-219-9-001*	5K, Trimpot
	008-231-9-001**	

Ref. No.	Part No.	Description
		CONTROLS AND RESISTORS(Cont'd.)
R22	008-221-9-001*	100K, Trimpot
	008-228-9-001**	
R23	008-222-9-001*	250Ω, Trimpot
	008-229-9-001**	
R24	008-220-9-001*	30K, Trimpot
	008-230-9-001**	
R25	008-218-9-001	100Ω, 30%, 25 Turn Trimpot
R26	***	4.7K, 5% 1/4 Watt, Carbon
		COMBINATION NETWORKS
RN1	012-005-9-001	Resistor Network
RN2	012-003-9-001	Resistor Network
RN3	012-004-9-001C	Resistor/Capacitor Network
RN4	012-002-9-001	Resistor Network
RN5	012-006-9-001	Resistor Network
		INDUCTOR
L1	041-067-9-001	560μhy Inductor
		SWITCHES
S1	083-177-9-001	Range
S2	083-178-9-001	Function
S3	084-040-9-001	Power, SPDT
		MISCELLANEOUS
D1, D2, D3	238-006-9-001	Display, 7-Element LED
D4	158-004-9-001	Display, (minus sign) single LED
F1	191-320-9-001	Fuse, 7AG, 1A
	260-057-9-001	Overlay, Front Panel
	260-058-9-001	Logo, Front Panel
	271-030-9-001	Case, Main (Plastic)
	271-031-9-001	Case, Bottom (Plastic)
	271-032-9-001	Case, Top (Plastic)
	380-120-9-001	Foot, 7/16" Disc
	380-230-9-001	Filter, Display (Plastic)
	427-014-9-001	10 Lead Jumper
	522-062-9-001	Black Test Lead (Banana to Insulated Clip)
	522-063-9-001	Red Test Lead (Banana to Probe)
	523-115-9-001	Negative Jack/Fuse Holder Assembly
	751-119-9-001	2 Knobs (Function & Range)
	763-041-9-001	Fuse, P.C.B. Mount
	769-081-9-001	Spring, Battery (Jumper Contact)
	769-080-9-001	Battery Contact (Single)
	769-077-9-001	Mask, Minus Sign
	773-059-9-001	Phone Jack, Subminiature
	653-018-9-001	Nut for Phone Jack (Miniature)
	342-030-9-001	Insulator, Vinyl (For Phone Jack)

Remove from unit. Causes TV interference.
Units with Vertical Trimpots (below Serial No. 39-03500).
Units with Horizontal Trimpots (above Serial No. 39-03500).
Part of 012-004-9-001C. If original network (RN3) is replaced, disregard resistor R26 and use proper RN3 as shown.
See Instruction Manual for Warning on substitution of Fusible Resistor R15.

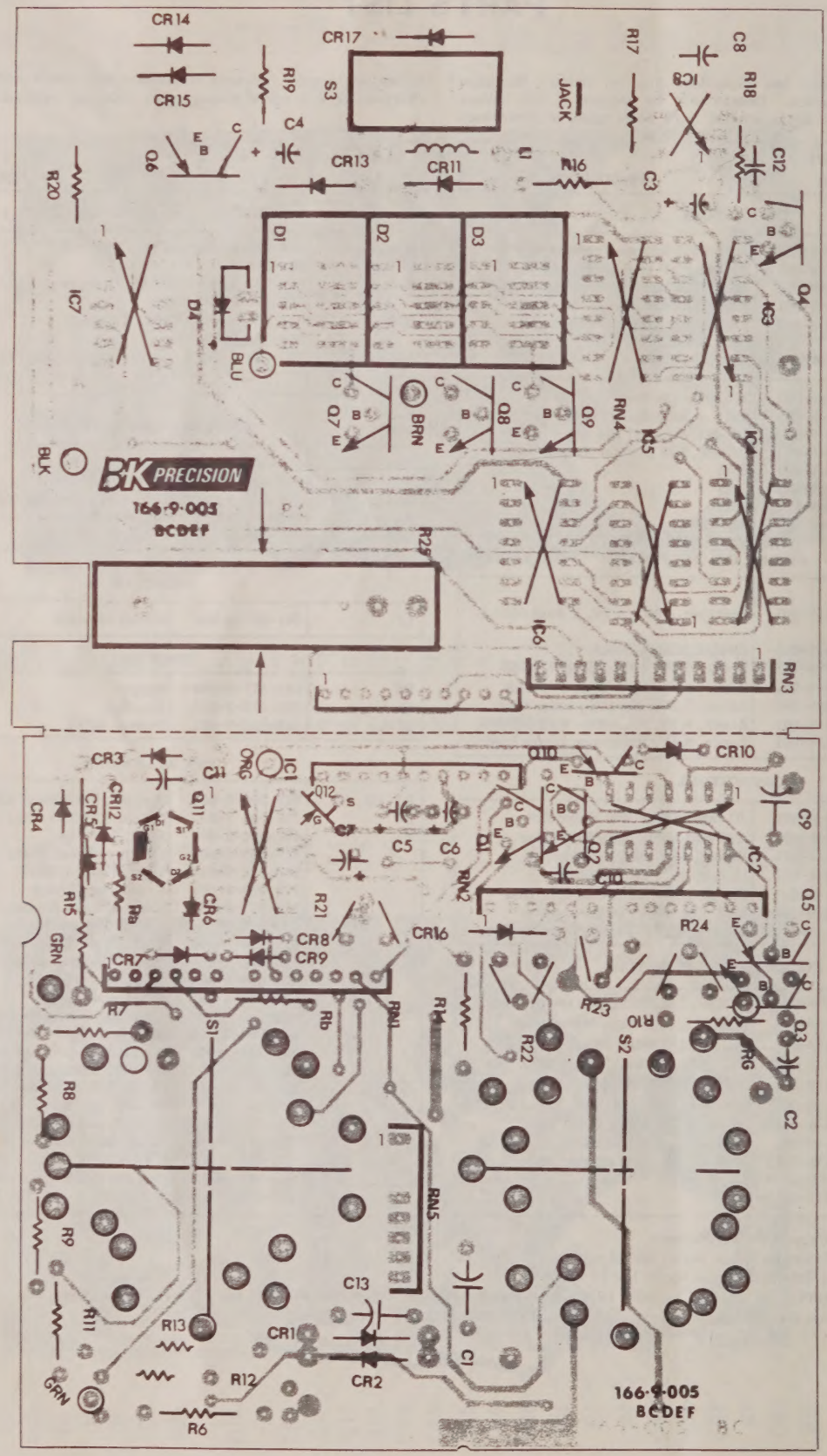


Fig. 2. Printed Circuit Board Layout, Component Side — Models Below Serial No. 39-03500.

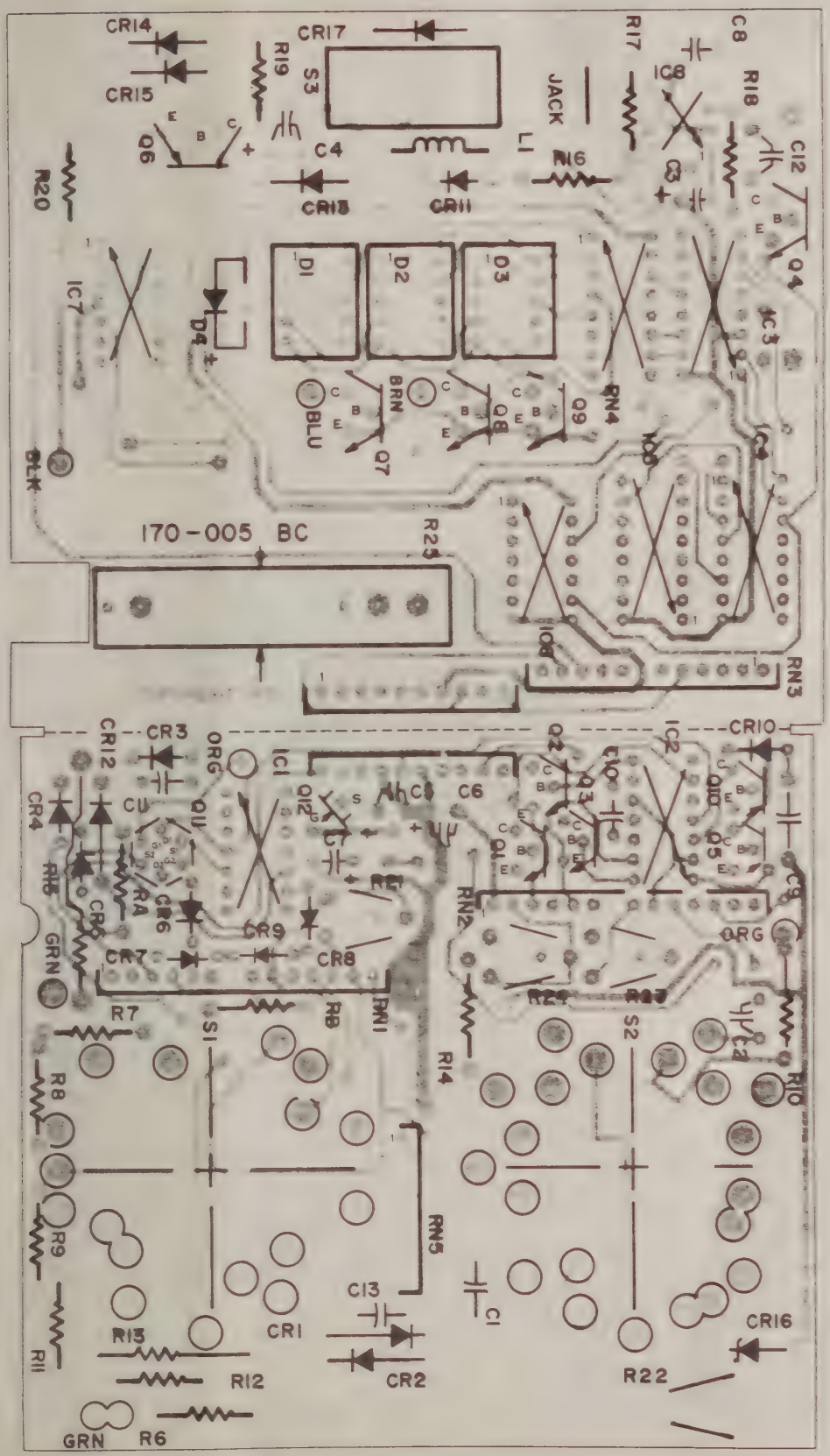
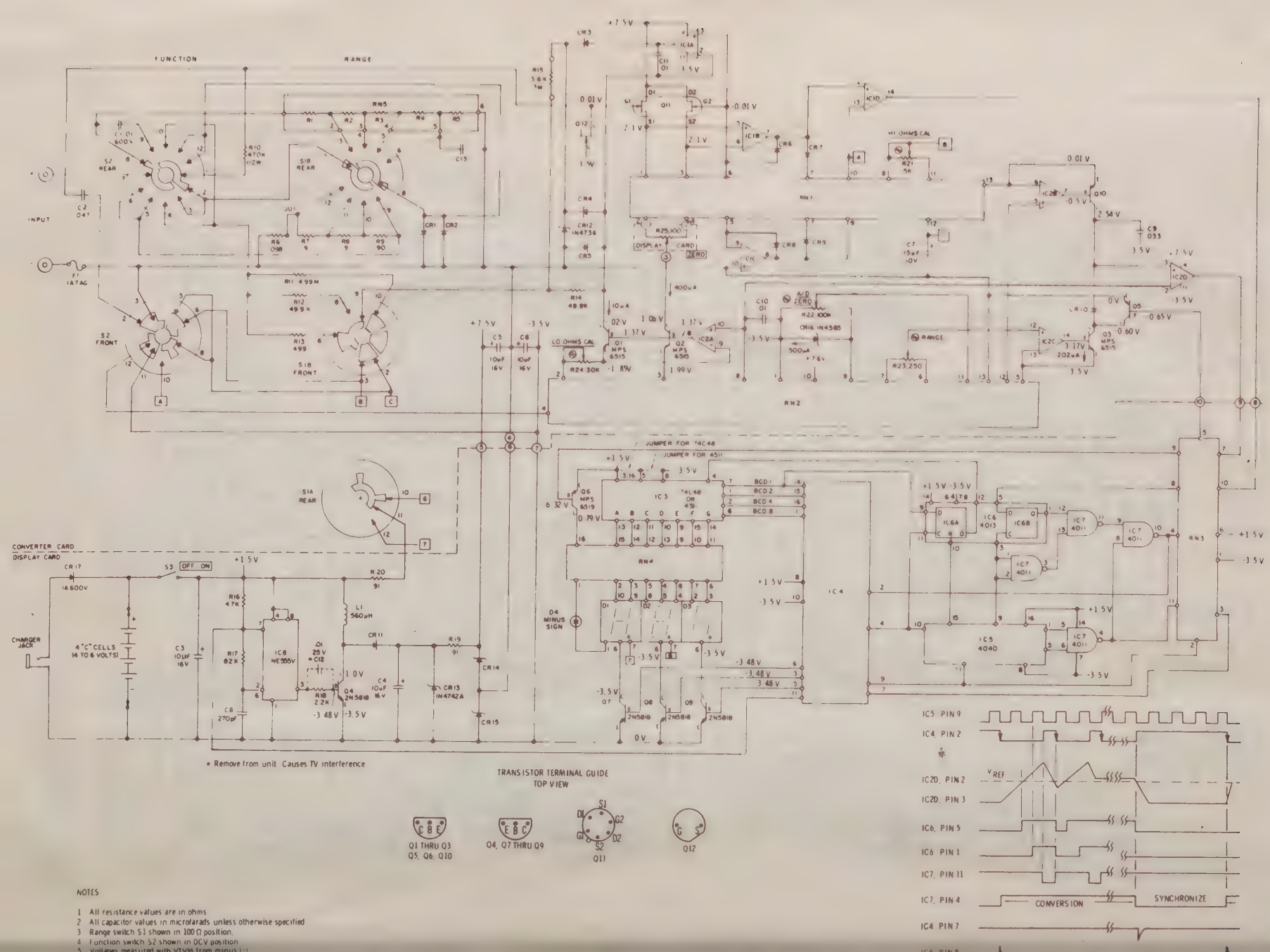


Fig. 3. Printed Circuit Board Layout, Component Side — Models Above Serial No. 39-03500.



* Remove from unit. Causes TV interference.

NOTES

1. All resistance values are in ohms
2. All capacitor values in microfarads unless otherwise specified
3. Range switch S1 shown in 100 Ω position.
4. Function switch S2 shown in DCV position
5. Voltages measured with VTVM from minus (-)

ACCOPRESS®

25970	YELLOW
25971	BLACK
25972	LIGHT BLUE
25973	DARK BLUE
25974	LIGHT GRAY
25975	LIGHT GREEN
25976	DARK GREEN
25977	TANGERINE
25978	RED
25979	EXECUTIVE RED

GENUINE PRESSBOARD

ACCO USA, INC.
770 S. ACCO PLAZA
WHEELING, IL 60090

46452